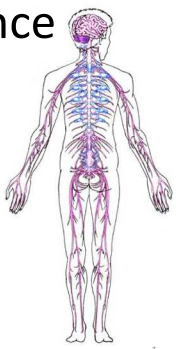


# CISC 3250 Systems Neuroscience

Neural systems and neuroanatomy

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JMH 328A



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## Levels of organization

Central Nervous System 1m

Systems 10cm


Networks 1mm

Neurons 100µm

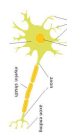
Synapses 1µm

Molecules 1Å

10<sup>11</sup> neurons



10<sup>8</sup> neurons

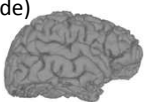


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## Elements of the central nervous system

- Cerebral cortex ■
- Thalamus ■
- Hypothalamus ■
- Brainstem ■ ■ ■
- Cerebellum ■
- Spinal cord

Lateral (side) view



Medial (inside) view

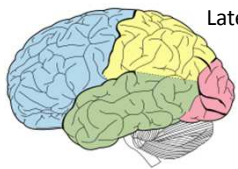


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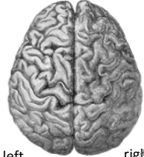
## Cerebral cortex broad divisions

- Four lobes
  - Frontal ■
  - Parietal ■
  - Temporal ■
  - Occipital ■
- Two hemispheres: left and right, linked by corpus callosum

Lateral view



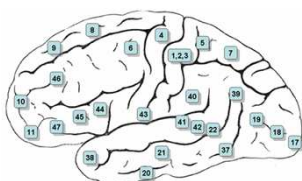
Dorsal (top) view



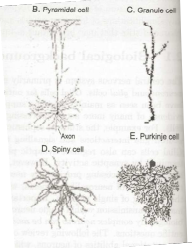
left right

## Brodmann areas

- Divide brain based on arrangement of neurons in each region



Lateral view

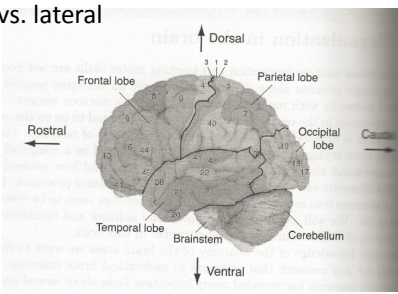


Common neuron types

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## Navigating the cerebral cortex

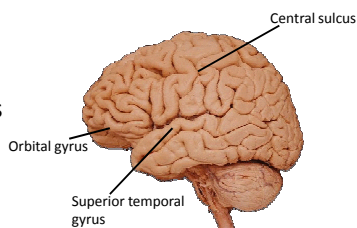
- Dorsal (top) vs. ventral (bottom)
- Anterior/rostral (front) vs. posterior/caudal (back)
- Medial vs. lateral



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### Dividing the cerebral cortex surface

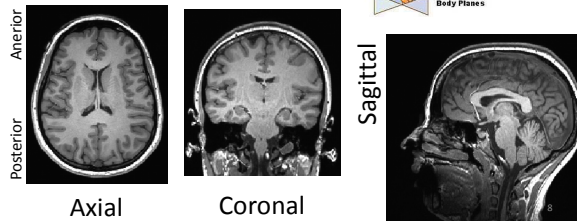
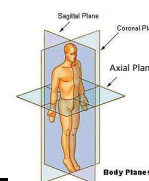
- Sulci – folds
- Gyri – bulges



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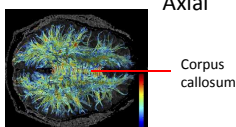
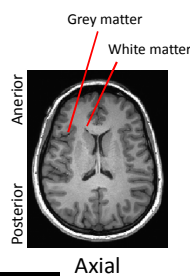
### Two dimensional slices of the brain

- Axial (parallel with ground)
- Coronal (halo)
- Sagittal (in profile)



### Grey and white matter

- Grey matter – soma, performs “computations”
- White matter (60% of brain) – axons, transmits information
- Tractography finds links between brain regions

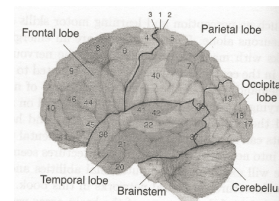


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<http://en.wikipedia.org/wiki/File:3DSlicer-KubickiUPR2007-fig6.jpg>

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### Functional divisions

- Frontal
  - Future planning, personality, judgment, social behavior
  - Motor cortex
- Temporal
  - Auditory cortex
  - High-level vision
- Parietal
  - Spatial vision
  - Primary sensory cortex
  - Visual-auditory-spatial sensory integration
- Occipital
  - Primary visual cortex

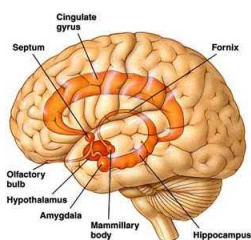


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### Limbic system

Medial area of cerebral cortex

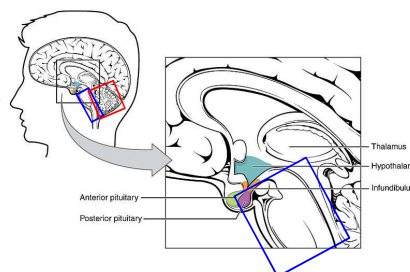
- Hippocampus: memory
- Amygdala: emotion
- Cingulate and parahippocampal gyri



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### The brain beyond the neocortex

- Thalamus
- Hypothalamus
- **Brain Stem**
- **Cerebellum**



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[http://en.wikipedia.org/wiki/File:1806-The\\_Hypothalamus-Pituitary\\_Complex.jpg](http://en.wikipedia.org/wiki/File:1806-The_Hypothalamus-Pituitary_Complex.jpg)

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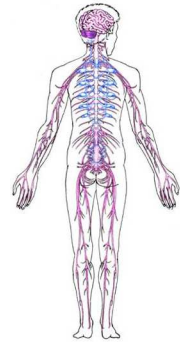
### The brain beyond the neocortex

- Thalamus
  - All sensory information (except olfaction/smell) passes through
- Hypothalamus
  - Emotions, memory
  - Homeostasis: temperature, sleep/alertness, hunger
- Brain Stem
  - Conduit for spinal cord and cranial nerves
  - Respiratory and cardiac activity
- Cerebellum
  - Plan, coordinate, modify motor activities

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### At the periphery

- Spinal cord
  - Muscles: motor
  - Mechanoreceptors: touch
- Sensory organs
  - Ears: Hearing and balance
  - Eyes: Vision
  - Olfactory bulb: smell



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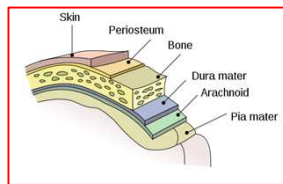
### Non-functional anatomy

- Vessels of the brain
- Ventricles with cerebrospinal fluid
- Casing around the brain – pia matter, dura matter

ventricle



Coronal



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